

WHAT IS CLAIMED IS:

1. A hard film for cutting tools which is composed of $(\text{Ti}_{1-a-b-c-d}, \text{Al}_a, \text{Cr}_b, \text{Si}_c, \text{B}_d)(\text{C}_{1-e}\text{N}_e)$
 $0.5 \leq a \leq 0.8, 0.06 \leq b, 0 \leq c \leq 0.1, 0 \leq d \leq 0.1,$
 $0 \leq c+d \leq 0.1, a+b+c+d < 1, 0.5 \leq e \leq 1$
(where a, b, c, and d denote respectively the atomic ratios of Al, Cr, Si, and B, and e denotes the atomic ratio of N.)
2. The hard film for cutting tools as defined in Claim 1, wherein the value of c is larger than 0.
3. The hard film for cutting tools as defined in Claim 1, wherein the values of a and b are in the range of $0.02 \leq 1-a-b \leq 0.30, 0.55 \leq a \leq 0.765, 0.06 \leq b,$ or $0.02 \leq 1-a-b \leq 0.175, 0.765 \leq a, 4(a-0.75) \leq b.$
4. The hard film for cutting tools as defined in Claim 3, wherein the value of (c+d) is 0.
5. The hard film for cutting tools as defined in Claim 1, wherein the value of e is 1.
6. The hard film for cutting tools as defined in Claim 1, which has the crystal structure mainly of sodium chloride structure.
7. The hard film for cutting tools as defined in Claim 1, wherein the sodium chloride structure is one which has the (111) plane, (200) plane, and (220) plane such that the intensity of diffracted rays from them measured by X-ray diffraction (θ -2 θ method), which is denoted by I(111), I(200), and I(220), respectively, satisfies expression (1) and/or expression (2) and expression (3) given below.

$$I(220) \leq I(111) \quad \dots (1)$$

$$I(220) \leq I(200) \quad \dots (2)$$

$$I(200)/I(111) \geq 0.1 \quad \dots (3)$$

8. The hard film for cutting tools as defined in Claim 1, wherein the sodium chloride structure is one which, when measured by X-ray diffraction (θ - 2θ method) with Cu $K\alpha$ line, gives the diffracted ray from the (111) plane whose angle of diffraction is in the range of from 36.5° to 38.0° .

9. The hard film for cutting tools as defined in Claim 8, wherein the diffracted ray from the (111) plane has a half width not larger than 1° .

10. A cutting tool which is coated with the hard film defined in Claim 1.

11. A process of forming hard film on cutting tools defined in Claim 1, said process comprising vaporizing and ionizing a metal in a film-forming gas atmosphere and accelerating the conversion of said metal and film-forming gas into a plasma, thereby forming a film.

12. The process of forming hard film on cutting tools as defined in Claim 11, wherein the vaporization and ionization of the target metal are accomplished by the arc ion plating method that employs arc discharging and the conversion of film-forming gas into plasma is accelerated in the vicinity of the substrate by the magnetic lines of force which:

a) are parallel to the normal at the target's evaporating surface, and

b) run toward the substrate in the direction parallel to or slightly divergent from the normal to the target's evaporating surface.

13. The process of forming hard film on cutting tools defined in Claim 12, wherein the bias voltage to be applied to the substrate is -50V to -400V with respect to earth potential.

14. The process of forming hard film on cutting tools defined in Claim 12, wherein the temperature of the substrate is kept at 300-800°C at the time of film forming.

15. The process of forming hard film on cutting tools defined in Claim 12, wherein the reactant gas for film forming has a partial pressure or total pressure in the range of 0.5 to 7 Pa.

16. A target used to form a hard film which is composed of Ti, Al, Cr, Si, and B and has a relative density not lower than 95%.

17. The target for a hard film as defined in Claim 16, which has a composition defined by

$(\text{Ti}_{1-x-y-z-w}, \text{Al}_x, \text{Cr}_y, \text{Si}_z, \text{B}_w)$

$0.5 \leq x \leq 0.8, 0.06 \leq y, 0 \leq z \leq 0.1, 0 \leq w \leq 0.1,$

$0 \leq z+w \leq 0.1, x+y+z+w < 1$

(where x, y, z, and w denote respectively the atomic ratios of Al, Cr, Si, and B.)

18. The target for a hard film as defined in Claim 16, which contains no pores or pores with a radius smaller than 0.3 mm.

19. The target for a hard film as defined in Claim 16, wherein the content of oxygen is 0.3 mass% or less, the content of hydrogen is 0.05 mass% or less, and the content of chlorine is 0.2 mass% or less.

20. The target for a hard film as defined in Claim 16, wherein the content of copper is 0.05 mass% or less and the content of magnesium is 0.03 mass% or less.